fined to one sex, and why is it indulged in whilst the females are away egg-laying, or presenting the strange phenomenon of a perfectly different habit from that indulged in by their lords and masters? It is of course quite reasonable to suppose that, if a number of exact observations be made, females in small numbers do visit puddles, and pools, and streams for drinking purposes. Certain it is that females come to sugar equally with males, but this we may take it is for food, and not for drink, and it is just in this that our difficulty lies. We know that moths and butterflies that visit sugar, over-ripe fruit, and similar dainties are of both sexes. They come, it seems, for food; but males alone seem to be attracted by pure water. Does their extra activity give them a greater need in this direction? and has a habit which was at first (and still is in a measure) a necessity become so pleasurable that excessive drinking has literally become a vice?"

MESSRS. SEELEY AND CO. will shortly publish a concise popular account of wireless telegraphy, by Mr. Richard Kerr, being the substance of lectures delivered by him in the principal cities of England, Scotland, and Holland. Mr. Preece will contribute a preface to the volume.

HERREN FEIEDLÄNDER, of Berlin, have just issued their Book-Catalogue No. 430, consisting of 103 pages, entirely devoted to the anatomy, physiology, and embryology of plants.

AN earnest appeal is made by the Rev. W. Porter, "Vonmueller," Arnold Street, South Yarra, Victoria, one of the trustees, for further contributions for the erection of a granite monument over the grave of the late Baron Ferdinand von Mueller, in the cemetery of St. Kilda.

DR. ERWIN F. SMITH reprints a lecture delivered before the Massachusetts Horticultural Society on the spread of plant diseases, in which he discusses the parts played respectively by insects and by the wind in the propagation of the diseases of plants.

THE May number of the *National Geographic Magazine* is devoted to an account of the geography, resources, and political conditions of Cuba, and contains as a frontispiece the portrait of Captain Charles D. Sigsbee, the commander of the ill-fated battleship *Maine*. For several years, prior to taking command of the *Maine*, Captain Sigsbee was Hydrographer of the Navy Department, and his contributions to our knowledge of the sea bottom, and its topography, place him in the front rank of scientific hydrographers.

MESSRS. TAYLOR, TAYLOR, AND HOBSON have issued a booklet of twenty-three pages setting forth the merits of their Cooke lens. Every photographer knows how difficult it is to obtain a lens which gives a sharply-defined image all over the field of view. By increasing the number of lenses, it is possible to overcome this difficulty and secure sharp definition even at the margins of a picture. The Cooke combination satisfies this photographic desideratum by the simplest means, only three lenses being used in its construction. The superiority of the lens over the symmetrical and other old types is strikingly shown in the book by a series of reproductions from the margins of plates.

THE eleventh part of Mr. Oswin A. J. Lee's illustrated work "Among British Birds in their Nesting Haunts" has been published by Mr. David Douglas, Edinburgh. Ten plates are included in this new part, representing nests of the robin, wren, rook, marsh tit, golden eagle, spotted flycatcher, teal, and pheasant. An insertion announces that the author is desirous of taking photographs of the nests of the following birds: kite, Montagu's harrier, honey buzzard, hobby, garganey, and ruff. If any reader is able to help Mr. Lee to procure these, intimation should be sent to him at 58 Manor Place, Edinburgh.

"WE have the satisfaction of being able again to look back upon a year of general activity and extended progress, which will bear comparison with any of its predecessors." The Report of the Marlborough College Natural History Society, from which these words have been taken, show that interest in scientific subjects is well fostered by the Society. The members are encouraged to observe and to contribute papers recording the results of their observation and reading, so that the Society, like other similar societies in our public schools, is of great assistance in developing very useful faculties. For instance, the following observation, by "E. A. M.," of climbing habit in frogs is interesting:—"Some frogs have taken up their abode for the last month in two deserted blackbirds' nests, built in round thick box bushes, about two feet from the ground. One frog is generally to be seen alone sometimes on or near the edge of the nest, sometimes comfortably ensconced in the middle, only his head peeping out. In the other nest there are now always two frogs." Mr. E. Meyrick describes and figures some cinerary urns discovered during excavations in the College grounds.

THE additions to the Zoological Society's Gardens during the past week include a Collared Peccary (*Dicotyles tajacu*) from South America, presented by Mr. Eustace Grey; a Gazelle (*Gazella dorcas*, ♂) from North Africa, presented by Mr. J. D. Lambert; a Short-headed Phalanger (*Petaurus breviceps*) from Australia, presented by Mr. Julian T. Pym; a Small Hill Mynah (*Gracula religiosa*) from India, presented by Mrs. Strather; a —— Squirrel (*Sciurus*, sp. inc.), three Schlegel's Doves (*Calopelia puella*) from West Africa, presented by Mr. W. H. Boyle; two Malabar Squirrels (*Sciurus maximus*, var. *dealbatus*) from India, presented by Mr. R. C. Wroughton; an Algerian Tortoise (*Testudo ibera*) from North Africa, presented by Mr. Albert West; a Smooth Snake (*Coronella austriaca*), British, presented by Mr. Bryan Hook; a Black-shouldered Kite (*Elanus cœruleus*), a Tachiro Goshawk (*Astur tachiro*), a Spotted Eagle Owl (*Bubo maculosus*), two Infernal Snakes (*Boodon infernalis*), two Lineated Snakes (*Boodon lineatus*), a Smooth-bellied Snake (*Homalosoma lutrix*), four Rough-keeled Snakes (*Dasypeltis scabra*), eleven Rufescent Snakes (*Leptodira hotambœia*), four Rhomb-marked Snakes (*Trimerorhinus rhombeatus*), fifteen Crossed Snakes (*Psammophis crucifer*), a Cape Adder (*Bitis atropos*), three Puff Adders (*Bitis arietans*) from South Africa, presented by Mr. J. E. Matcham; a Gazelle (*Gazella*, sp. inc., ♂) from Senegal, two Black-striped Wallabies (*Macropus dorsalis*, ♂ ♀) from New South Wales, a Canadian Skunk (*Mephitis mephitica*), a Florida Tortoise (*Testudo polyphemus*) from North America, a Beccari's Cassowary (*Casuarius beccarii*) from New Guinea, a Sharp-nosed Crocodile (*Crocodilus acutus*) from Jamaica, deposited; two Mantchurian Cranes (*Grus japonensis*) from North China, purchased; an African Wild Ass (*Equus tæniopus*, ♂), two Barbary Wild Sheep (*Ovis tragelaphus*), two Black-necked Swans (*Cygnus nigricollis*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

SUN WORSHIP BY TUSAYAN INDIANS.—In the fifteenth annual report of the U.S. Bureau of Ethnology, and in recent numbers of the *American Anthropologist*, Dr. J. Walter Fewkes gives a detailed account of a group of the ceremonials which form the ritual practised by the Tusayan Indians. It has been known for some years that the aborigines of the semi-deserts in the south-western portion of the United States possess a remarkably elaborate system of belief and ceremonial, and Dr. Fewkes has devoted a considerable amount of attention to them in order to determine the significance of the various parts of the ritual followed. In the course of his investigations he has made a number of interesting observations on the astronomical means used for determining the time for ceremonials. He has found

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that among the Hopi Indians there are priests skilled in the lore of the sun, who determine, by observation of the points on the horizon where the sun rises or sets, the time of the year proper for their religious observances. An important ceremony is performed at the winter solstice, and in December 1897 Dr. Fewkes made a special journey to Arizona to study the ritual on the spot. This is not the place to refer to the ethnological aspects of the ceremonials witnessed by him, but the following extract from the Report of the U.S. Bureau of Ethnology will interest students of primitive astronomy.

"We are justified in accepting the theory that sun and moon worship is usual among primitive men. Whether that of the sun or of our satellite was the earlier, it is not in the province of this article to discuss, but it is doubtless true that sun worship is a very ancient cult among most primitive peoples. The Pueblos are not exceptions, and while we cannot say that their adoration is limited to the sun, it forms an essential element of their ritual, while their anhydrous environment has led them into a rain-cloud worship and other complexities. I think we can safely say, however, that the germ of their astronomy sprang from observations of the sun; and while yet in a most primitive condition they noticed the fact that this celestial body did not always rise or set at the same points on the horizon. The connection between these facts and the seasons of the year must have been noted early in their history and have led to orientation, which plays such an important part in all their rituals. Thus the approach of the sun to a more vertical position in the sky in summer and its recession in winter led to the association of time when the earth yielded them their crops with its approach, and the time when the earth was barren with its recession. These epochs were noticed, however, not by the position of the sun at midday, but at risings and settings, or the horizon points. The two great epochs, summer and winter, were, it is believed, connected with solstitial amplitudes, and the equinoctial, horizontal points, unconnected with important times to agriculturists, were not considered as of much worth. There is every evidence, however, that the time of day was early indicated by the altitude of the sun, although the connection of the altitude at midday with the time of year was subordinated to observations on the horizon."

STELLAR RADIATIONS.—Referring again to the problem of the measurement of stellar radiations, mentioned in our issue of May 12 (p. 39), the recent improvement in galvanometers ought to help the matter towards solution. At the meeting of the Physical Society on May 13, Prof. Ayrton said that the sensitiveness of these instruments had increased during the last few years in the ratio of 27 to 3,310,000. Of course it must be remembered that these figures apply to a particular class of instrument, and that they are based upon a somewhat empirical definition of the factor of sensitiveness. Nevertheless, they do indicate advance in the refinements of current-measurement.

It is to be hoped that similar attention may now be given to perfecting an electrometer for extremely small potential-differences; such an instrument is required for the development of photo-electricity generally. The sensitive plates of the cells used by Prof. Minchin for stellar measurement are only a few square millimetres in area; the advantage of this is that several of them can be placed together at the focus of a telescope. Their function is, not to give current, but potential differences when exposed to light. They respond chiefly to yellow radiations, and each plate, irrespective of its size, gives from one-third to one-half a volt, for daylight. If electrometers could be improved in the ratio 27 to 3,310,000, the experiments made by Pouillet, just fifty years ago, might be extended almost to the circumjovial planets.

THE LATE PROF. SOUILLART.—At the meeting of the Paris Academy of Sciences on May 23, M. Callandreau gave a short account of the late Prof. Souillart, whose death we have already announced. Prof. Souillart was elected a Correspondant of the Academy in succession to M. Gyldén, the Academy thus showing its esteem for the astronomer who during thirty years devoted his leisure to the study of the theory of the satellites of Jupiter, and succeeded in bringing out important complements of the chief work of Laplace. It was while studying under M. Puiseux, at the Normal School, that M. Souillart had his inclination turned to celestial mechanics. In 1865 his "Essai sur la théorie analytique des satellites de Jupiter" appeared in the *Annals* of the School, and formed the basis of two later memoirs—one, published by the Royal Astronomical Society, devoted to the analytical theory of the movements of the satellites; while the other, dealing with the reduction of the formulæ to numbers, appeared in the thirtieth volume of the "Mémoires des Savants étrangers." In addition to these publications, a series of notes appeared in the tenth, eleventh, and twelfth volumes of the *Bulletin astronomique*. The whole of these works formed the basis of the treatment of the satellites of Jupiter given by M. Tisserand in his "Traité de Mécanique céleste."

When M. Souillart left the Normal School he was appointed professor of mathematics in the Saint-Omer High School, and at the same time was attached to the Faculty of Sciences at Nancy. In 1873 he became professor of mécanique rationelle at Lille University, and, some years later, professor of astronomy, which post he occupied at the time of his death.

THE INDUSTRIAL APPLICATIONS OF ELECTRO-CHEMISTRY.

THAT electricity is able to bring about chemical change appears to have been observed for the first time about the middle of last century. With Volta's discovery of the principle of his pile, in 1792, it became possible to set larger quantities of electricity in motion, and in 1800, the year in which Volta described his first large battery, the study of the chemical effects of the electric current may be said to have commenced with the observations of Nicholson and Carlisle on the electrolysis of water. They were the first to notice the separate evolution of the products of the decomposition at opposite poles; so that our knowledge of electrolysis, upon which the majority of the applications of electro-chemistry depend, may be said to have been acquired in the nineteenth century.

In the early 'thirties it was repeatedly proposed to deposit metals by immersing the object to be coated in a solution of the metal, placing it in contact with a more oxidisable metal. An external source of current was applied to electrotyping in 1839 by Jakobi, Spencer and Jordan independently of each other; the first-named also describes the employment of electrolytic gas in producing lime-light. The use of a current generated by magneto-electric machines was patented in 1842, and, according to Mr. Swan, current generated in this way was employed by Messrs. Elkington at Birmingham in that year. It was not, however, until 1864–5 that the more perfect machines of Pacinotti and Wilde made it possible to produce the electric current at a sufficiently economical rate to permit of its employment in a chemical process on the manufacturing scale. The electrolytic refining of copper was patented by Mr. J. Elkington in 1865 and 1869, and in the latter year the first electrolytic copper refinery was erected at Pembrey, near Swansea. The progress of electro-chemical industry was at first slow, but the improvements in dynamos and steam-engines, stimulated by the rapid extension of the applications of electricity to lighting and other purposes, the development of water powers, and last, but not least, the impetus given to the study of electro-chemistry by the theories of Van 't Hoff and Arrhenius, have contributed to make this progress during the past decade extraordinarily rapid. A circumstance, the effect of which on the future development of the applications of electro-chemistry is not to be underrated, is the evolution of a new type of chemist—one, namely, who adds to his knowledge of chemistry a competent knowledge of physics and especially of electricity; there can be no doubt that the country in which the facilities for obtaining training of this kind are defective will be heavily handicapped in the future. With special electro-chemical laboratories being founded at almost every university and polytechnic in Germany, it is depressing to see so little being done in our own country (more especially since it is apparently becoming increasingly difficult for foreigners to obtain admission to the German laboratories).

The present position of technical electro-chemistry has not been attained without many failures; instructive and interesting as many of these are, it is impossible to refer to them within the limits of this article, which must, therefore be confined to a general description of processes actually employed.

The oldest and most important of these is the electrolytic copper-refining process. The copper containing 0·3 to 2 per cent., or sometimes more, impurity is cast into plates which are suspended, some 3 or 4 inches apart, in large, lead-lined wooden boxes. Between each pair of plates a thin sheet of pure copper is suspended, and the solution, containing 15 to 20 per

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